Northeast Consortium

The University of New Hampshire • Woods Hole Oceanographic Institution
The University of Maine • Massachusetts Institute of Technology

Interim Final Report

Project Title: Developing a protocol for sampling juvenile groundfish in rocky habitat

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Abstract

This project was designed to provide preliminary data on juvenile groundfish populations in rocky habitats inside the Western Gulf of Maine Closure Area (WGOMCA) compared to similar habitats outside but near the closure, and to assess gillnets as sampling tools. Very little information exists on the effects of the closure on fish populations in rocky areas because nearly all sampling has been done using trawls and mainly over soft-bottom areas with low vertical relief. Identical gillnets (two 300-ft panels per net, 4-in stretched mesh) were set over five days (2 - 7 October 2005) for ~24-hour soaks at five pairs of sites; i.e., on each day one site was fished inside the WGOMCA and one outside. Contrary to what was expected, most of the fish caught were adults, including cod up to about 50 lb. Total groundfish biomass was about 3.5x greater at sites inside the closure compared to those outside. Hence, although little was learned about the nursery function of the rocky habitats for juvenile groundfish, the data suggested that the closure may be having a significant effect on groundfish populations, perhaps contributing to stock re-building. The data also indicated that gillnets can be an effective sampling tool in rocky habitats. Based on the results of this study, additional funding was obtained from NEC for more intensive research using gillnets to assess the effects of the WGOM closure on fish populations in rocky habitats.

Introduction

There is a need to assess the effectiveness of fishing closures such as the Western Gulf of Maine Closure Area (WGOMCA) on fish habitat and groundfish populations. Most routine groundfish sampling protocols (e.g., NMFS groundfish survey) rely on bottom trawling. Trawls of the sizes typically used in the region may be rigged for a range of bottom types but they are not effective on rocky bottoms with substantial vertical structure. Thus, groundfish monitoring and research programs in rocky habitats must use other types of gear.

The overall management goal of the WGOMCA is stock re-building via "depleted stock protection" (Wooninck and Bertrand 2004), which can include a variety of ecological functions affecting all life stages of the managed species. Although a variety of gears (e.g., lobster traps, recreational fishing, shrimp trawls) are still permitted in the area, all commercial fishing gears capable of retaining groundfish are prohibited. Hence, a major goal is protection of habitat from the potentially damaging effects of mobile bottom gear. Stocks of several managed species in the region have shown consistent upward trends over the past several years, suggesting that various management measures, including area closures, are working. However, there has been little rigorous assessment of how the WGOMCA may be contributing to the stock re-bounds.

Recent research on "spillover" effects (Murawski et al. 2004) and groundfish movement patterns (Howell and Goethel 2004) that involved the WGOMCA has indicated little if any effect of the closure on movements of adult groundfish in the general area. Howell and Goethel (2004) concluded with regards to cod: "Cod show no preference for movement into the closed area [WGOM], i.e. the area does not appear to be a sink. There is also no evidence of wholesale movement out of the closed area, i.e. the area does not appear to be a particularly important source of adults. The area may be a source of eggs, larvae, and juveniles, and may be an important nursery area, but such functions need to be verified."

Much of the WGOMCA encompasses Jeffreys Ledge which consists largely of rocky bottom with substantial vertical relief in some areas. This kind of bottom typically functions as nursery habitat for groundfish species such as cod (Collette and Klein-MacPhee 2002), and can be severely damaged by mobile gear (Watling and Norse 1998; Auster and Langton 1999; Johnson 2002; NRC

2002). For Atlantic cod in particular, Fahay et al. (1999) listed as a research need "…the importance of certain bottom habitat types for the survival of young-of-the-year." There is a need to better characterize the role of rocky areas as groundfish nursery habitat and the effectiveness of marine closures such as the WGOMCA in protecting such habitat.

Research has been conducted on methods for using gillnets as fishery-independent sampling tools in shallow coastal waters (Gray et al. 2005; Rotherham et al. 2006). Although standard protocols have not been fully developed, the potential influences of soak times, mesh size, and net length on catch per unit effort (CPUE) estimates have been examined. However, we are aware of no previous work on protocols for continental shelf waters. Also, no standard protocol exists for sampling fish populations in rocky habitats with large vertical relief. Development of such a protocol is needed to assess the effectiveness of marine closures such as the WGOMCA.

Project objectives

The project was designed to meet the following objectives: (1) determine the effectiveness of small mesh gillnets for capturing juvenile groundfish in rocky habitats; (2) develop a general protocol for the use of small mesh gillnets in sampling juvenile groundfish in rocky habitats; and (3) provide preliminary data on how the WGOMCA may be protecting juvenile habitat.

Participants

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Methods and work plan

The overall study design was a “control-impact” assessment with sites chosen inside and outside the closed area, and compared using an “in vs. out” assessment (Osenberg & Schmitt 1996). Sampling sites were chosen along a portion of Jeffreys Ledge inside the closure and at comparable sites west of the closure, most within a 150 mi^2 area (Fig. 1) that had been recently studied for various ecosystem characteristics (see Grizzle et al. 2005 and 2008 for summaries).

Identical gillnets (two 300-ft panels per net, 4-in stretched mesh) were set over five days (2 - 7 October 2005) for ~24-hour soaks at five pairs of sites; i.e., on each day one site was fished inside the WGOMCA and one outside. Captured fish were removed from the nets, measured (total length), counted, and weighed by species. All live fish were quickly processed and released; dead fish were discarded.

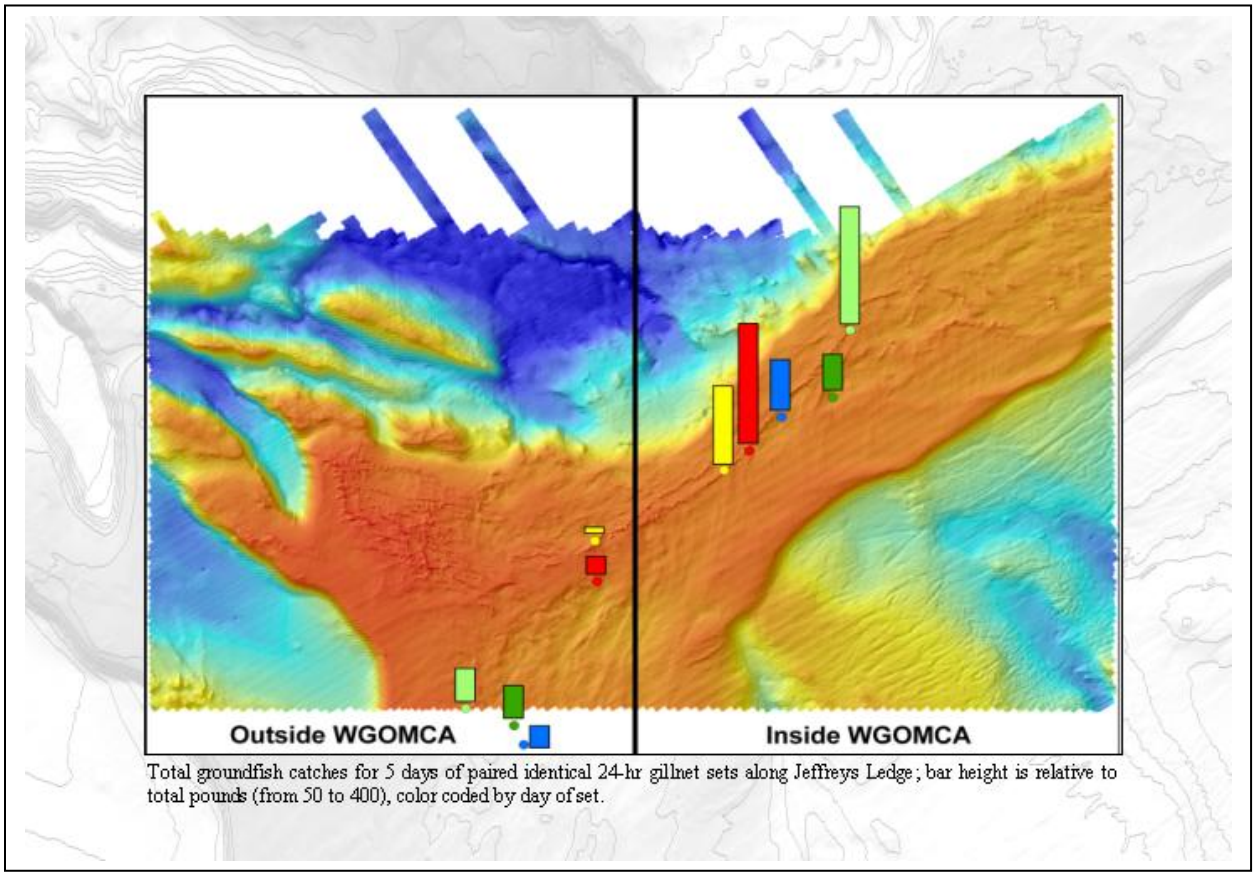

Fig. 1. Wet weight (pounds) for groundfish only (colored bar graphs; see Fig. 2 for data) plotted by gillnet sampling sites within 150 mi^2 study area from earlier NEC-funded study of the Western Gulf of Maine Closure Area (WGOMCA; "Grizzle et al. Study Area" green box on inset map). Base map is 5-m pixel resolution bathymetric multibeam map from earlier study; water depths shown by color ranging from red (<50 m) to dark blue (>180 m).

Data

The major data resulting from the project are summarized below (Fig. 2). Because the project resulted in a full proposal and NEC funding for more extensive research, it is anticipated that all resulting data will be submitted to the NEC Fisheries and Ocean Database when the overall project is completed.

Results and conclusions

The project touched upon at least portions of all four major objectives of NEC: development of partnerships between commercial fishermen and scientists; bringing fishermen's information, experience, and expertise into the scientific framework needed for fisheries management; enabling commercial fishermen and commercial fishing vessels to participate in cooperative research; and utilizing commercial fishing vessels as research platforms. The project also provided data useful in assessing the impacts of a major fishing closure with respect to how it might be achieving its intended goals relevant to stock re-building.

A particularly important finding was the much greater biomass (overall 3.5x more) of groundfish inside the closure compared to outside (Fig. 2), suggesting that the WGOMCA may indeed be affecting some aspects of groundfish stock recovery. Due to the preliminary and short-term nature of the study, however, such a conclusion should only be viewed as tentative.

A surprising finding that affected the design of the full proposal that resulted from the project was that very few juvenile fish were captured, even though relatively small mesh nets were used. The ongoing project uses mesh sizes ranging from 2-in to 8-in, and involves sampling in a much broader study area as well as over all four seasons.

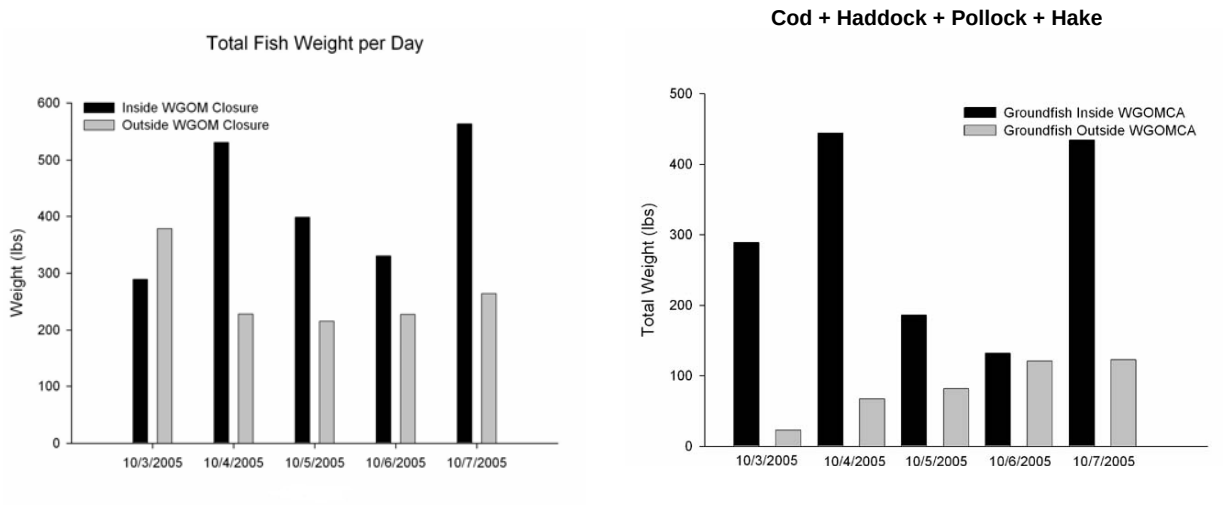

Fig. 2. Raw data for wet weights from each gillnet set for total fish (left) and groundfish only (right).

Partnerships

The present project was the result of extensive collaboration between scientists and fishermen. It would not have been possible without the knowledge of fishing methods and the study area by Mike Leary. Several scientists were present on all cruises to process fish and record data. The overall result was sufficient information to design, prepare and submit a research proposal for additional funding (see above).

Impacts and applications

As mentioned above, no standard protocol exists for sampling fish populations in rocky habitats with large vertical relief. Based on the substantial differences in biomass of fish caught at rocky bottom sites inside the WGOMCA compared to outside, further development of such a protocol could be important for adequately assessing the effectiveness of marine closures such as the WGOMCA in protecting groundfish habitat. Future studies should be designed to provide more spatially and temporally extensive data, and to assess how bottom characteristics such as vertical relief are related to fish habitat quality.

Related projects

The present project was a direct result of findings from an earlier NEC project (Grizzle et al. 2005, 2008), which was co-funded by UNH Cooperative Institute for New England Mariculture and Fisheries (CINEMAR; now the Atlantic Marine Aquaculture Center). The current development project led to submission and funding for a more extensive study to better assess the impacts of the WGOMCA on fish populations in rocky habitats (Grizzle et al. 2007).

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Presentations

Ecosystem studies of the Western Gulf of Maine closure area: Management implications. R.E. Grizzle, January 11, 2006. Northeast Regional Sea Grant Meeting, Roger Williams University.

Effects of the Western Gulf of Maine closure area on benthic habitats. R.E. Grizzle, March 3, 2006. Maine Fishermen's Forum, Rockport, ME.

Effects of the Western Gulf of Maine closure area on seafloor habitats: GIS-based assessments. R.E. Grizzle, L.G. Ward, L.A. Mayer, A.B. Cooper, A.A. Rosenberg, M. Brodeur, J.K. Greene, H. Abeels, M. Malik. April 11, 2006. Geographic Information Systems and Ocean Mapping in Support of Fisheries Research and Management, Massachusetts Institute of Technology, Cambridge, MA.

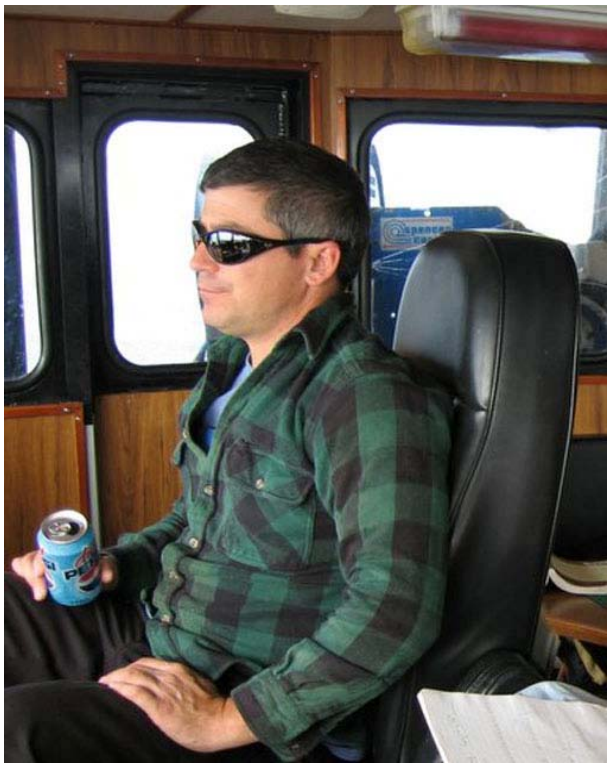
Student participation: None

Published reports and papers: None

Images: (see below)

Large cod (~50 lbs) caught inside the Western Gulf of Maine closure area.

F/V Lori B at Gloucester, MA dock.



Captain Mike Leary drinking on the job.

Troy Brock, Tom Daniels, and Holly Abeels – all working hard, earning their pay.